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Original Article

# PHYSIOLOGICAL EFFECT OF MICRONUTRIENT ON UPTAKE OF MAJOR NUTRIENT BY PLANT AND OIL CONTENT OF SEED OF SESAME CROP FOR COASTAL ODISHA SITUATION

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***ABSTRACT***

***An Action Research was conducted by the Plant Physiology Researchers in 2014-15 in the Dept of Plant Physiology, College Of Agriculture, OUAT, Bhubaneswar in order to study the Physiological Effect of micronutrient on uptake of major nutrients by Sesame plant and micronutrient is the only key factor in enhancing oil seed content in the pod of Oil Seed Crops. The coastal Odisha situation is very good condition where Oilseed Crop can be grown well and cope up with the climatic condition. Here the Researchers want to draw the conclusion to transfer the technology based on How to increase oil content in Oil Seed Crop by applying the appropriate amount of Micronutrient. There is a pool and energy, inertia is working for the intake of Major Nutrients by Micronutrients.***

***KEYWORDS: Effect of Micronutrient, Oil Seed Crops & Major Nutrients***

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## INTRODUCTION

Sesame Crop is a Leading Crop and Queen of all Oil seed crops. Sesame crop has the capacity to cope up with the adverse condition and can yield best.

In Odisha, the deficiency of micronutrients has been observed in light –textured red and lateritic acid soils. The situation has been aggravated by the introduction of high yielding crop varieties and intensive cropping system. As the demands of nutrients for the higher yields increase and plant requirements for major nutrients are only met micronutrient deficiencies are likely to become acute. In Odisha soil, the deficiency of micronutrients like Zn, B, and Mo has been reported both by farmers, extension and research workers. Low seed yield, due to deficiency of above micronutrients, have been well recognized due to several reasons such as flower and fruit drop, low harvest index and poor vegetative growth.

The role of different micronutrients has been well established in plant metabolism. Zn, as micronutrients, is involved in the biosynthesis of auxins, indole -3-acetic acid. It participates in the metabolism of the plant as an activator of several enzymes. Boron is involved in the carbohydrate transport within the plant which helps in translocation of sugar and DNA synthesis in meristems. Also, it has been implicated in cellular differentiation and development, nitrogen metabolism, fertilization, active salt absorption, hormone metabolism, water relations, fat metabolism, phosphorus metabolism and photosynthesis. Molybdenum has long been implicated in gaseous nitrogen fixation and nitrate assimilation. Zinc (Zn) and manganese (Mn) is important micronutrients in sesame

production. Reduced growth hormone production in Zn deficient plants causes shortening of internodes and short leaves resulting in malformation of fruit with little or no yield. Mn is essential for photosynthesis reactions, enzyme activation and root growth (Mortvedt*et al*., 1999). Therefore, the steady supply of macro nutrients and Zn was found to increase stem height and nodes for capsule development in sesame. Major micronutrients like nitrogen, phosphorus and potassium along with micronutrients such as zinc and manganese are influencing the growth and yield of sesame.

Keeping all the above facts into consideration, the present investigation has been undertaken to study the effect of micronutrients applied as foliar spray, on metabolism, growth and yield of sesame crop with the following objectives.

## MATERIALS AND METHODS

Here the researchers were followed Randomized Block Design for conducting this research. A concrete field plan and calendar were strictly followed by the Young Scientists under the supervision of Plant Physiologist, Soil Chemist and Agronomist. Critical care was taken time to time and micronutrient application as per the schedule. 10 replications had been made for getting a concrete result. The Following Calculations were derived from this experiment with statistical variations.

**Harvest Index**

$$\textbf{HI} = \frac{\text{Seed yield}}{\text{Total dry matter of plant}} \times 100$$

## STATISTICAL ANALYSIS

**Analysis of Variance**

The data collected from the experiment on various aspects of growth, yield and yield attributing characters of sesame were arranged in appropriate tables according to the treatments and were subjected to statistical analysis appropriate to the design (panse and sukhatme, 1985). The treatment variations were tested for significance of the F test. The standard error of mean (SE (m)) and critical difference (CD) at 5% were calculated as

$\text{SE (m)} = \sqrt{}\,(\text{EMS} \div r)$

Where the EMS = error mean sum of squares

R = number of replications

$\text{CD (0.05)} = \text{SE (m)} \times \sqrt{2} \times \text{t (0.05) at error d. f.}$

## RESULTS AND DISCUSSIONS

By conducting the above experiment, the researchers were able to get the following result as discussed below.

Major Nutrient Uptake by Sesamum plant

## UPTAKE OF N, P, K IN PLANT

**N content and uptake**

N content in different plant parts and its uptake were estimated at harvest and presented in table 9.

N content (%) in various plant parts varied among the treatments and ranged a maximum of 1.4 to a minimum of 0.52 % in leaf, 0.17 to 0.10 % in stem and 1.96 to 1.08 % in seed. Among the treatments the highest N content was recorded in $T_9$ and lowest in $T_1$. Irrespective of treatments N content in different plant parts was founded in the order of seed N content >leaf>stem. Significant increase in N content was observed in all the plant parts with foliar application of micronutrients over the control except in seed where application of Cu ($T_5$) and Mn ($T_7$) were at par with control. Among the treatments foliar application of combined micronutrients ($T_9$) registered significantly the highest N content in leaf, stem and seed followed by B ($T_2$), commercial mixture ($T_{10}$), Zn ($T_3$) and Mo ($T_4$) in that order.

N uptake by plant and plant parts differed among the treatments and varied from a minimum of 8.97, 4.52, 32.67,46.1 mg in ($T_1$) to a maximum of 57.26, 14.7, 125.6 and 197.5 mg in ($T_9$) by leaf, stem, seed and whole plant respectively. The result indicated that partitioning of N uptake by the plant was in the order of uptake in seed > leaf > stem. The low uptake of N was recorded in $T_1$ (control) while all the foliar application of micronutrients increased N uptake significantly. Among all the treatments $T_9$ registered the highest N uptake followed by Zn ($T_3$), B ($T_2$), commercial mixture ($T_{10}$) in leaf, Zn ($T_3$), B ($T_2$), Mo ($T_4$) in the stem, B ($T_2$), commercial mixture ($T_{10}$), Zn ($T_3$) in seed and B ($T_2$), Zn ($T_3$) and commercial mixture ($T_{10}$) in whole plant respectively.

**P Content and Uptake**

The P content and uptake by plant parts and whole plant at harvest were presented in table 10.

Irrespective of treatments, P content in different plant parts was founded in the order of seed P content > leaf > stem. P content (%) in various plant parts varied among the treatments and ranging from 0.37 to 0.48 % in leaf, 0.23 to 0.34 % in stem and 0.49 to 0.57% in seed. The data revealed that there was a significant increase in P content of

**Table 1: Effect of Different Micronutrients on Nitrogen Content and Uptake**

| Treatments | Nitrogen content (%) | | | Nitrogen uptake(mg/plant) | | | |
|---|---|---|---|---|---|---|---|
| | Leaf | Stem | Seed | Leaf | Stem | Seed | Total |
| $T_1$ | 0.52 | 0.10 | 1.08 | 8.97 | 4.52 | 32.67 | 46.1 |
| $T_2$ | 1.22 | 0.15 | 1.36 | 36.13 | 10.51 | 80.20 | 126.8 |
| $T_3$ | 0.98 | 0.14 | 1.36 | 36.55 | 10.68 | 74.14 | 121.3 |
| $T_4$ | 0.87 | 0.14 | 1.36 | 24.76 | 8.23 | 69.51 | 102.5 |
| $T_5$ | 1.01 | 0.15 | 1.22 | 19.89 | 6.55 | 48.32 | 74.7 |
| $T_6$ | 1.15 | 0.16 | 1.36 | 20.44 | 7.66 | 55.16 | 83.2 |
| $T_7$ | 0.94 | 0.15 | 1.19 | 24.19 | 8.25 | 52.70 | 85.1 |
| $T_8$ | 1.05 | 0.14 | 1.29 | 27.72 | 7.25 | 53.41 | 88.3 |
| $T_9$ | 1.4 | 0.17 | 1.96 | 57.26 | 14.7 | 125.62 | 197.5 |
| $T_{10}$ | 1.05 | 0.14 | 1.68 | 29.08 | 8.19 | 77.73 | 115.0 |
| **SE(m)±** | **0.059** | **0.008** | **0.072** | **1.741** | **0.496** | **3.884** | **6.102** |
| **C.D(0.5)** | **0.17** | **0.02** | **0.21** | **5.17** | **1.47** | **11.53** | **18.12** |

Stem over control by foliar application of all micronutrients except Co ($T_8$) and combined micronutrients ($T_9$). Whereas, P content in leaf and seed were found in significant among the treatments.

P uptake by plant parts and whole plant showed variation among the treatments at harvest. The P uptake varied from 7.52 to 16.98 mg in leaf, 10.33 to 29.82 mg in stem, 15.82 to 32.86mg in seed, and 33.67 to 69.23mg in whole plant. The result indicated that P uptake by plant partitioned in order of P uptake by seed >stem >leaf. Foliar application of all the micronutrients and its combination significantly increased P uptake in the leaf over the control except Cu ($T_5$) and Fe ($T_6$). Among the treatments, the highest uptake of Pin leaf was recorded by the application of Zn (16.98mg) followed by $T_9$

(15.31mg), $T_2$ (14.21mg), T4 (13.11mg). Foliar application of all the micronutrients significantly increased P uptake in stem over control. Significantly the highest P uptake was recorded 29.82mg in $T_2$ followed by $T_3$, $T_4$, $T_9$ and $T_{10}$ which were at par among them. P uptake by seed and whole plant showed a similar trend in response to foliar application of micronutrients. Maximum P uptake by seed (32.86 mg) and (69.23 mg) per plant in T9, which followed closely by $T_2$, $T_3$ and $T_4$.

**K Content and Uptake**

The K content (%) and uptake by different plant parts and whole plant were presented in table 11. The data revealed that the K content varied from 1.06 to 1.31% in leaf, 1.75 to 1.97% in stem and 0.25 to 0.34% in the seed, which indicated that K content in stem >leaf >seed. Among the treatments the highest K leaf content 1.31% was recorded in $T_8$ and the lowest in $T_7$. However, no significant change in leaf K content was observed among the treatments. Significant increase in K content of the stem was recorded due to foliar application of B ($T_2$), Fe ($T_6$), Cu ($T_5$) and combination of micronutrients ($T_9$) over the control but the rest of the treatments found non significant as compared to control. K content in seed didn’t differ significantly over control, however the highest K content was recorded in $T_{10}$ followed by $T_9$ and the least was recorded in $T_3$.

The uptake of K by plant parts and whole plant (table-11) revealed that it varied from a minimum of 19.23mg ($T_1$) to a maximum of 53.17 mg ($T_9$) in leaf, 75.4mg ($T_1$) to 157.5 mg ($T_9$) in stem, 9.03mg ($T_1$) to 21.63mg ($T_9$) in seed and 103.6mg ($T_1$) to 232.3 mg ($T_9$) in whole plant. This indicated that the partitioning of K uptake among the plant.

**Table 2: Effect of Different Micronutrients on Phosphorous Content and Uptake**

| Treatments | Phosphorous content (%) | | | Phosphorus uptake (mg/plant) | | | |
|---|---|---|---|---|---|---|---|
| | Leaf | Stem | Seed | Leaf | Stem | Seed | Total |
| $T_1$ | 0.44 | 0.23 | 0.52 | 7.52 | 10.33 | 15.82 | 33.67 |
| $T_2$ | 0.48 | 0.34 | 0.51 | 14.21 | 29.82 | 30.44 | 68.31 |
| $T_3$ | 0.45 | 0.29 | 0.52 | 16.98 | 22.13 | 28.74 | 67.86 |
| $T_4$ | 0.46 | 0.36 | 0.56 | 13.11 | 21.10 | 28.82 | 63.04 |
| $T_5$ | 0.46 | 0.33 | 0.53 | 8.99 | 14.26 | 21.05 | 44.31 |
| $T_6$ | 0.46 | 0.28 | 0.55 | 8.25 | 13.69 | 22.14 | 44.10 |
| $T_7$ | 0.37 | 0.36 | 0.56 | 9.51 | 20.34 | 24.82 | 54.68 |
| $T_8$ | 0.37 | 0.24 | 0.57 | 9.79 | 12.93 | 23.66 | 46.39 |
| $T_9$ | 0.37 | 0.25 | 0.51 | 15.31 | 21.05 | 32.86 | 69.23 |
| $T_{10}$ | 0.45 | 0.34 | 0.49 | 12.66 | 19.76 | 22.80 | 55.23 |
| **SE(m)$\pm$** | **0.024** | **0.018** | **0.025** | **0.672** | **1.061** | **1.478** | **3.098** |
| **C.D(0.5)** | **NS** | **0.05** | **NS** | **1.99** | **3.15** | **4.39** | **9.20** |

**Table 3: Effect of Different Micronutrients on Potassium Content and Uptake**

| Treatments | Potassium content (%) | | | Potassium uptake(mg/plant) | | | |
|---|---|---|---|---|---|---|---|
| | Leaf | Stem | Seed | Leaf | Stem | Seed | Total |
| $T_1$ | 1.12 | 1.75 | 0.30 | 19.23 | 75.4 | 9.03 | 103.6 |
| $T_2$ | 1.28 | 1.97 | 0.25 | 37.98 | 138.4 | 14.68 | 191.1 |
| $T_3$ | 1.26 | 1.75 | 0.25 | 47.09 | 133.5 | 13.57 | 194.2 |
| $T_4$ | 1.18 | 1.81 | 0.30 | 33.60 | 106.5 | 15.59 | 155.7 |
| $T_5$ | 1.25 | 1.87 | 0.26 | 24.50 | 81.9 | 10.25 | 116.7 |
| $T_6$ | 1.21 | 1.97 | 0.29 | 21.46 | 94.6 | 11.72 | 127.8 |
| $T_7$ | 1.06 | 1.83 | 0.28 | 27.20 | 101.0 | 12.40 | 140.7 |
| $T_8$ | 1.31 | 1.76 | 0.30 | 34.65 | 91.2 | 12.37 | 138.3 |
| $T_9$ | 1.30 | 1.87 | 0.33 | 53.17 | 157.5 | 21.63 | 232.3 |

| **Table 3: Contd.,** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **$T_{10}$** | 1.25 | 1.77 | 0.34 | 34.62 | 103.8 | 15.73 | 154.2 |
| **SE(m)±** | **0.082** | **0.040** | **0.017** | **1.921** | **6.199** | **0.789** | **9.081** |
| **C.D(0.5)** | **NS** | **0.11** | **NS** | **5.70** | **18.17** | **2.34** | **26.98** |

Parts in the sequence of K uptake in stem > leaf > seed. All the foliar application of micronutrients enhanced K uptake in different plant parts as well as per plant as compared to control. Foliar application of all the micronutrients in combination ($T_9$) registered the highest K uptake followed by Zn ($T_3$), B ($T_2$) and commercial mixture ($T_{10}$) in leaf, B ($T_2$), Zn ($T_3$), Mo ($T_4$) in the stem, commercial mixture ($T_{10}$), Mo ($T_4$) and B ($T_2$) in seed and Zn ($T_3$), B ($T_2$) and Mo ($T_4$) in whole plant. However foliar application of Cu ($T_5$) and Fe ($T_6$) didn't register any significant change in the K uptakeper plant as well as in leaf.

## YIELD, YIELD ATTRIBUTES AND OIL CONTENT

Yield, yield attributes and oil content were depicted in table-12.

Number of capsules per plant differed significantly among the treatments. It varied from a minimum of 25.1 to maximum 35.8 capsules per plant among the treatments. Foliar application of all the micronutrients significantly increased the number of capsules per plant over the control except Cu ($T_5$) and Fe ($T_6$) whereas the highest number of capsules was found in ($T_9$) followed by B ($T_2$), Zn ($T_3$) and Mo ($T_4$).

Shelling percent varied among the treatments. The highest shelling percent (52.16%) was recorded in $T_9$ and the lowest (31.85%) in $T_1$ among the treatments. Foliar application of all the micronutrients showed significant increase in shellingpercent over the control except Mo ($T_4$) and Cu ($T_5$).

Number of seeds per capsule varied among the treatments and ranged a minimum of 45.8 to a maximum of 55.6. Foliar application of all the micronutrients alone or in combination as well as their commercial mixture significantly increased the number of seeds per capsule over the control except the application of Cu ($T_5$). Among all the treatments the highest seeds per capsule was obtained in ($T_9$) followed by B ($T_2$), Zn ($T_3$) and Mo ($T_4$).

Variation in seed size was noticed among the treatments. The highest thousand seed weight (3.22g) and the lowest (2.62g) were recorded in $T_9$ and $T_1$ respectively. However, no significant difference was observed among the rest treatments with respect to thousand seed weight.

**Table 4: Effect of Different Micronutrients on seed Yield and its Components**

| Treatments | No. of Capsule/ Plant | Shelling (%) | No. of Seeds /Capsule | 1000 Seed Weight (G) | Seed Yield /Plant (G) | Yield Kg/Ha. | HI (%) | Oil (%) |
|---|---|---|---|---|---|---|---|---|
| **$T_1$** | 25.1 | 31.85 | 45.8 | 2.62 | 3.01 | 662.6 | 28.84 | 43.2 |
| **$T_2$** | 35.2 | 42.80 | 52 | 3.21 | 5.87 | 1292.6 | 29.03 | 48.6 |
| **$T_3$** | 33 | 46.43 | 51.6 | 3.19 | 5.43 | 1195.0 | 25.26 | 49.3 |
| **$T_4$** | 31.9 | 37.97 | 50.2 | 3.18 | 5.09 | 1120.3 | 30.09 | 47.4 |
| **$T_5$** | 26.2 | 33.13 | 47.8 | 3.15 | 3.94 | 867.8 | 32.25 | 44.6 |
| **$T_6$** | 26.4 | 38.67 | 48.6 | 3.15 | 4.04 | 889.1 | 30.73 | 45.1 |
| **$T_7$** | 28.0 | 42.00 | 49.9 | 3.17 | 4.42 | 974.4 | 28.21 | 45.3 |

| Table 4: Contd., | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **$T_8$** | 26.7 | 42.22 | 49.2 | 3.14 | 4.12 | 907.4 | 27.57 | 44.9 |
| **$T_9$** | 35.8 | 52.16 | 55.6 | 3.22 | 6.40 | 1410.0 | 24.75 | 50.2 |
| **$T_{10}$** | 29.1 | 39.03 | 50 | 3.18 | 4.62 | 1017.9 | 28.54 | 46.5 |
| **SE(m)$\pm$** | **0.533** | **2.254** | **0.876** | **0.182** | **0.274** | **60.377** | **1.576** | **0.837** |
| **C.D(0.5)** | **1.58** | **6.69** | **2.60** | **NS** | **0.81** | **179.36** | **NS** | **2.48** |

Seed yield per plant varied among the treatments. Foliar application of micronutrients significantly increased seed yield per plant over the control. The highest seed yield (6.40g/plant) was recorded in $T_9$ followed by $T_2$ (5.87g), $T_3$ (5.43g), $T_4$ (5.09g) per plant.

Seed yield per hectare showed a similar trend as it was found in seed yield per plant. The highest seed yield 1410 kg per hectare was obtained by combining micronutrients ($T_9$) which registered 112% higher yield followed by 95% for B ($T_2$), 80% for Zn ($T_3$) and 69% for Mo ($T_4$) over control ($T_1$).

Harvest index varied in the range between 32.25 and 24.75 but no significant variation was found between the treatments.

Variation in oil content was observed among the treatments. Foliar application of micronutrients in combination ($T_9$) registered the highest oil content (50.2%) followed by Zn (49.3%), B (48.6%), Mo (47.4%) and commercial mixture (46.5%) which were significantly higher over control. However, no significant difference in oil content was observed in the rest of the treatments.

## CONCLUSIONS

By undergoing this type of Experiment by the Scientists a technology has been developed for the farmers. Finally the Scientists are aware about the tricks and tips for growing oilseed crops by enhancing oil content in the pod and capsule by injecting micronutrients which is lead to uptake major nutrients hence be justified.

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